Food for the Soil: Rock Phosphate as Fertilizer

Machine for turning rock phosphate/fertilizer mixture into pellets. (Photo: P. van Straaten)

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If you're a subsistence farmer in sub-Saharan Africa, you probably don't have much extra money for fertilizer. But fertilizer is what you need to enrich the phosphate-poor tropical soil that you till. Phosphorus encourages early rooting, general health, and larger yields. Without it, crops are thin, plants are stunted, and leaves of corn, for example, turn an odd purple colour. Years of continuous cropping, on top of eons of weathering and leaching, have made the soil in many parts of Africa phosphate-poor.

Yet dotted like geological islands in a dryland sea are places where inorganic phosphate may be mined from old rock deposits. However, the rich fines, or dust, discarded from mining are only useful if their inorganic phosphate can be turned into an organic form that local staple crops — corn, beans, millet, sorghum, and vegetables — can actually absorb.

Partners

That's the challenge that faced Peter van Straaten when he began research in Zimbabwe, Kenya, and Uganda in the early 1990s, with funding from the International Development Research Centre (IDRC). Since then, Dr van Straaten, an agrogeologist at the University of Guelph, and Dr Rei Fernandes, the project leader in Zimbabwe, have found more than one way to improve soil fertility. IDRC's current funding partners are the International Centre for Research in Agroforestry (ICRAF), the Rockefeller Foundation, and Africa 2000, a non-government organization. The University of Zimbabwe has also played a role.

During the project, a team of researchers and farmers in three African countries blended phosphate mine waste or rock phosphate concentrate with "triple superphosphate" fertilizer. When the mix is placed in soil and watered, it starts a chemical reaction that frees phosphorus that plants can use.

Pellet maker

One of the project's spinoffs is a low-tech machine, first developed and built in Zimbabwe, that can turn the rock dust/fertilizer mixture into cleaner and more easily handled pellets. The pellet machine is both easy to build and popular. When researchers showed photos of it to artisans in Uganda and Kenya, they replicated it for about US$200 apiece.

The rock-phosphate approach to improving soil has a long history at IDRC, which funded initial tests in Tanzania in the early 1980s. Further projects followed in Ethiopia, Sri Lanka, and across sub-Saharan Africa.

Complex hypothesis

Dr van Straaten says the original idea of blending rock phosphate with triple superphosphate fertilizer was based on a complex hypothesis involving thermodynamics. The combination of water and triple superphosphate was thought to produce a strong acid that attacks insoluble inorganic phosphates and converts them into a form that is more available to plants. That theory turned out to be an oversimplification. But despite not fully understanding the process, the research team has realized their main aim — finding ways to use low-cost, locally available supplements to fertilize crops.

"We are interested mainly in helping small-scale subsistence farmers get out of poverty by improving soil fertility and hence crop yields," says Dr van Straaten.

Phosphorus-deficient manure

In Zimbabwe, although local farmers have expressed interest in the rock-phosphate fertilizer, they mainly want to improve the performance of manures that they have traditionally used. Tests revealed that the manure from the project area was also low in phosphorus. "So we supported the idea of improving the phosphorus-deficient manures with locally available phosphate sources. In the meantime, we have established some better management techniques for the collection and storage of manures. We are improving the phosphorus content of manure by adding these pellets and we're actually reducing nitrogen losses as well. It's a very simple but very effective method," stresses Dr van Straaten. "Our strength was, I think, that the farmers participated as partners in the process."

The researchers have also transferred the rock-phosphate technology to Uganda and Kenya, and are now promoting it in Mali, Burkina Faso, Senegal, and other West African countries. According to Dr van Straaten, the technique has the potential to help farmers wherever there is highly weathered and phosphorus-deficient soil, and rock phosphate deposits exist.

Economic savings

His team is currently calculating the economics of the technique. In Zimbabwe, it appears to halve the cost of imported fertilizers. In Kenya, the savings are even more impressive: a mixture of 90 percent local rock phosphate is blended with just 10 percent imported fertilizer.

In addition, the researchers are trying to find ways to further reduce African farmers' reliance on imported fertilizer, by exploring the feasibility of using other local alternatives. One highly promising method involves mixing organic waste from plants — in particular, the Mexican sunflower and some local varieties of kale — with rock-phosphate dust. These plants add some nitrogen and potassium nutrients to the mixture, resulting in a total "NPK" (nitrogen-phosphorus-potassium) fertilizer.

Low-cost fertilizers

"I'm pushing very hard to make more use of organic material plus inorganic rock material to come up with some local low-cost fertilizers for small-scale farmers," says Dr van Straaten. "We are very enthusiastic about our results, and we hope we can continue along these lines."

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